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related phenomena, as displayed in the history of the germ-cells and in the early stages of embryological development. This tendency of cell-research, with which students of cytology are sometimes reproached, is not wholly due to the high theoretical interest of the germ-cells. It is in large measure a result of purely practical conditions, such as the large size of the cell-elements in germ-cells or embryonic cells, the ease with which they may be obtained in all stages of development, and the accurate control of results thus rendered possible. Similar reasons may be given for the large share of attention that has been devoted to special forms of tissue-cells, such as the epithelial cells and leucocytes of salamander-larvæ, or the embryonic cells of plant-tissues. Cytological teaching has inevitably followed in the main, the lines of research; and thus it has come to pass that in practice, courses in cellular biology cover a very different field from those in histology, requiring special material and employing special methods.

Botanical students have been fortunate in the existence of Strasburger's well-known *Botanisches Practicum* which, though primarily devoted to general botanical morphology, also contains valuable directions for the practical study of plant-cytology. Students of zoology have had no lack of general works, such as those of Flemming, Carnoy, Bergh, Hertwig, Henneguy and Wilson, not to mention a number of admirable works on histology; but with the exception of Carnoy's *Biologie Cellulaire*, published fifteen years ago and the first of its kind, none of these works contain practical laboratory directions. Carnoy's work is now too far out of date to be of much service to the modern student, and the same applies to Whitman's excellent *Methods in Microscopical Anatomy and Embryology* published in 1885. A. Bolles Lee's *Microtometist's Vade-mecum*, especially in the German edition, translated and revised by Paul Mayer, is indispensable to all students of microscopical anatomy, yet even this work does not supply the want which Hæcker has now endeavored to meet.

The '*Praxis und Lehre*' will, we feel sure, be of the highest service both to students and to teachers of cytology. As the name indicates,

it is not properly a laboratory manual, but happily combines practice with descriptions of fact and the discussion of theory. The plan followed is to describe a series of 'objects,' each accompanied by practical directions for the collection and preparation of material, a brief and clear account of the topic which it illustrates, and a review of the earlier history and more recent literature of the subject. The methods, like many of the descriptions, are in the main compiled from recent original works, and the author has wisely omitted all accounts of elementary operations such as the use of the microscope, methods of section-cutting and the like, which are adequately treated in Lee's and other manuals. The student is thus brought directly to the real subject-matter and is enabled to gain a connected idea of the facts, learning at the same time how to procure and prepare the material for first-hand knowledge. Some of this material, it is true, is not readily procurable, some is practically out of the reach of all who are not specialists. Professor Hæcker has none the less rendered a good service, especially to teachers, by bringing together in readily available form the widely scattered accounts of material and method given by special investigators. The book is a model of clearness and brevity, and is well illustrated by figures drawn as far as possible from the latest sources. While we do not doubt that further experience will suggest many improvements on the practical side, the book may be heartily recommended as a most useful adjunct both to lecture-courses and to practical work in cytology, and one that cannot fail to give a stimulus to the study.

E. B. W.

The Teaching Botanist. By WILLIAM F. GANONG, PH.D., Professor of Botany in Smith College. New York, The Macmillan Company. 1899. Pp. xii + 270. Price, \$1.10.

The growth of interest in the teaching of botanical science has found expression in the publication during the past few years of a liberal number of books, concerned in one way or another with this teaching. Up to this time these works naturally fall into two categories—that of the text-book and of the laboratory manual—and although some attempt has been

made to combine the virtues of these two classes in one book, no very marked result has been delivered. Attempts have also been made to embody advice and suggestions to the teacher in minor paragraphs, but these have been necessarily meagre and their educational value somewhat doubtful. The teaching body, therefore, has been waiting for the right kind of help—help which is not sandwiched into the text-book or into the laboratory manual, but designed for the teacher solely. This has been given them in the work before us, one which is divided into two parts, the first part consisting of 'Essays on Botanical Pedagogics,' the second of 'An Outline for a Synthetic Elementary Course in the Science of Botany.' The author in his preface calls attention to the fact that in the opinions of many teachers the 'vital phenomena, especially as they manifest themselves in moulding the physiogony of vegetation,' should form the backbone of an elementary course in botany, and while admitting the value of this as an ideal, remarks that the problem of the topography of vegetation is far too complex a matter, too far beyond our understanding to be available in general courses. It appears to the reviewer that this is well said, for we are now experiencing a swing of the pendulum towards the use of ecology which will have to be lessened before the proper mean is arrived at. Passing on to the introduction we find the key to Professor Ganong's position as to what should constitute an elementary course. He says, "it must embody the essence of the best human knowledge of the leading divisions of the science, and that it must include training in those qualities by which that knowledge is gained."

The first part is made up of eight chapters, to the captions of which it is worth while here to draw attention. They are as follows: (1) The Place of the Sciences in Education and of Botany among the Sciences; (2) What Botany is of most Worth; (3) On Things Essential to Good Botanical Teaching; (4) On Scientific Recording, Drawing and Description; (5) On Laboratories and their Equipment; (6) On Botanical Collections and other Illustrations; (7) On Botanical Books and their Use; (8) On Some Common Errors Prejudicial to Good

Botanical Teaching. It must be left to the titles to suggest the scope and usefulness of these essays, with the assurance that the one who is interested will not be disappointed. It may be well, however, to point out a few matters of special interest which will serve to indicate the character of the whole. In facing the problem of the crowded curriculum, the author makes the plea that the Natural Sciences should be added to the curriculum as alternatives with the older well-established branches. Following which is an argument for a limited elective system in the schools. The contents of the second chapter has already been indicated in a sentence from the introduction. Among features deemed essential to good botanical teaching is a 'determination for incessant improvement.' This involves work in original investigation, as it is truly regarded as the only way in which the teacher can cultivate the right scientific spirit. In the sixth chapter the matter of collections is dealt with; the author emphasizes the necessity of making a collection mean something, which is seldom enough the case. We have passed beyond the cabinet stage of development. The last of the chapters deals with common botanical errors, most of which grow out of the partial failure on the part of teachers to readjust themselves to the newer phases of botanical thought, and although this chapter would be unnecessary, if the contents of the third essay had not been violated, it is under the circumstances not the least necessary of the series, as the reviewer can say from his own experience in contact with teachers. The value of these essays is here only suggested, and while it is certain there will be some disagreement as to minor features—for when has there been entire agreement among the teachers?—the whole forms a well-balanced, corrective and stimulating body of matter.

The second part embodies in outline what in the author's experience has proved to be the most profitable course of study for elementary students. The course consists in the study of the seed, germination, the seedling and the differentiated plant, with inquiry into the structure, physiology and ecology of the same. A series of a dozen simple experiments has been worked out to illustrate the essential physiolog-

ical processes in plants and is here presented. Following the treatment of the Spermatophytes in the manner indicated is work on the great groups of plants. There will be some who will take exception to the choice of types. Marchantia, for example, is a very antiquated and highly respectable laboratory type and possesses historical inertia, but it is hardly the best possible representative of the Hepaticæ. Concerning these outlines it may be said that only the broad lines are laid down, and plenty of work is left for the teacher to do in intelligently planning the details of the laboratory work. The most valuable and distinctive feature in this portion of the book is the discussion of the pedagogics involved in each stage of the course. These must be passed with bare mention, though they deserve full treatment.

It is satisfactory to know that morphological study is considered of great value in the training of students and that the diagrammatic rather than the artistic representation should be required.

A few inadvertencies have crept in. Longitudinal sections of a Scilla or Hyacinth flower passing through two stamens will not give an appearance of the ovary as represented in pages 239 and 240, as such sections would pass through one of the partitions. It is not at all certain that the willow flower is theoretically primitive, and much more uncertain is it that 'color develops * * * to show where the nectar is.' Insects at least, it appears, are probably color-blind, but possess a keen sense of smell. And it is to be hoped that the essay on page 175 will not be read as an example without drawing attention to the incorrect use of the word 'endosperm,' for which 'food materials' would better be substituted.

Altogether, however, we have in Professor Ganong's book a very useful and timely work, which will surely do a great deal towards the bettering of botanical teaching in the schools, and one, moreover, as unique as useful.

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Reye's Geometrie der Lage. Lectures on Geometry of Position. By THEODORE REYE, Professor of Mathematics in the University of Strassburg. Translated by THOMAS F. HOLGATE,

M.A., Ph. D., Professor of Applied Mathematics in the College of Liberal Arts in Northwestern University. New York, The Macmillan Company. 1898. Part I., 8vo. Pp. xix + 248.

As is well known this book, of which the first edition was published not more than thirty years ago, is the outgrowth of lectures delivered before the engineering students in the Polytechnic school at Zürich. These students were later to take lectures on Graphical Statics by Professor Culmann who, in the treatment of his subject, made free use of Von Staudt's 'Geometrie der Lage.' To get the most out of Culmann's work it was necessary that the student should not only be well acquainted with the conics, quadric surfaces, etc., but that he should also have what may be called a well-cultivated geometric imagination, in order that he might easily realize for himself a clear mental picture of the space figures which play such an important part in the engineer's work.

It is hardly too much to say that for the special purpose he had in view, no better means than the projective geometry could have been employed by Professor Reye; and one who has read his masterly treatment of the subject must always be grateful to him for the pleasure and profit derived therefrom.

It seems to us that there is a rapidly growing interest in pure geometry in this country, and that its real merit as an instrument of education is coming to be more fully recognized. Rightly presented, the charm of the subject itself, which is free from the trammels of the metric geometry of Euclid, is immediately experienced by students.

Although the geometry of position is often introduced by means of cross ratios, which (at least apparently) involve measurements, yet Reye's treatment is entirely free, even at the beginning, from any dependence upon metric relations. He has, however, beautifully shown that metric relations, especially those connected with the conic sections, present themselves very naturally as special cases of general non-metric theorems.

This, of course, may also be said of two other excellent books, viz., Cremona's 'Projective Geometry' and Von Staudt's 'Geometrie der Lage'; but Von Staudt is too brief to be easily